Patent Application

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TITLE OF INVENTION

COLD-FORGED HITCH RECEIVER AND METHOD OF MAKING THE SAME

FIELD OF INVENTION

[0001] The present invention relates in general to reinforcing the end of a metal tube, and in particular, to the novel manufacture of a component for a motor vehicle trailer hitch assembly and resultant receiver tube component having an integral, reinforced lip created through plastic deformation of tube stock.

BACKGROUND

[0002] So as to provide towing capability, vehicles are often fitted with hitch assemblies capable of connection with a trailer for hauling boats, travel trailers, utility trailers, etc. Typical hitch assemblies, as shown in FIG. 1, include a hitch receiver tube permanently mounted to the towing vehicle frame or body using one or more cross braces. The receiver tube, which has a pair of opposed pin-receiving apertures, opens toward the rear of the vehicle for removably receiving a hitch bar. Hitch bars are typically square, cross-sectional solid bars of metal having a pin bore therethough at one end for sliding engagement within the receiver tube and a mounting ball at the other end. Thus, when the hitch bar pin bore is aligned with the pin-receiving apertures of the

receiving tube, a pin may be inserted therethrough to maintain to connection. A trailer tongue can now be connected to the mounting ball of the hitch bar for towing a trailer.

[0003] As illustrated in FIG. 2, receiver tubes are conventionally formed from sheet metal stock and welded to form a closed section. Therefore, a seam weld exists longitudinally along the receiver tube as indicated by the dotted line in FIG. 2. The presence of a seam weld gives rise to the concern over mechanical failure of the receiver tube along the weld seam. This concern, as well as the significant loads acting on the hitch bar-receiving end, leads to the requirement that the receiving end be reinforced.

[0004] There are two manners of construction known in the art for manufacturing a receiver tube having a reinforcing ring; a) welding a separate reinforcing ring on one end of the tube stock, or b) folding an end portion of the tube stock upon itself to create a resultant reinforcing ring. There are several disadvantages to each manner of construction.

[0005] As explained in greater detail below, welding a reinforcing ring over one end of the receiver tube end has numerous disadvantages. First, the weld beads joining the receiver tube and the reinforcing ring are a prime area for the generation of corrosion, thus possibly leading to a reduction in weld strength and creating an undesirable appearance when a trailer is not connected thereto. Further, because the reinforcing ring is fitted to the receiver tube with separation gaps therebetween, water, dirt, and contaminants can be trapped therein leading to

further corrosion problems effecting the strength and appearance of the receiving tube. Also significant is the fact that the multi-piece construction of the separate retainer ring construction requires two components to be separately manufactured, transported, handled, and welded in order to manufacture the receiver tube.

[0006] Likewise, there are several disadvantages with creating a receiver tube having a reinforcing ring by folding an end portion of the tube stock upon itself to create the resultant reinforcing ring. First, there is generally a need to heat the tube end to an elevated temperature to promote folding of the tube stock onto itself. Also, by folding the tube stock a gap is created that is capable of retaining water, dirt, and contaminants within the fold. Such contaminants collecting in the fold can cause rusting and corrosion that, as indicated above, can affect the strength and appearance of the receiver tube. Further, because there is a tight fit between the receiver tube and the hitch bar, such contaminant collection in the fold could prevent the proper insertion of the hitch bar.

[0007] The present invention addresses each of these disadvantages and more to provide an improved manufacturing method and resultant receiver tube.

[0008] The present invention will be more fully described in the following written description with reference to the accompanying drawings.

SUMMARY OF THE INVENTION

[0009] The present invention provides an improved method for integrally reinforcing an end of a metal tube, and a resultant receiver tube for a motor vehicle trailer hitch assembly, wherein the method and resultant tube does not require creating a fold in the metal tube to create an integral reinforcing lip. The integral lip is formed by plastically deforming a length of the first end of the tube extending beyond the die. Preferably, the deformable length of the tube is less than or equal to two times the wall thickness of the tube.

[0010] The resulting trailer hitch receiver tube has a much-improved appearance having no weld beads or rough metal edges visible. The integral construction also eliminates pockets for contaminant collection caused by folding and welding and provides exceptional reinforcement for the tube seam weld. The absence of folds or welds provides a smooth surface for the hitch bar may slidably enter into the receiver tube. Further, the interior of the receiver tube can be radiused to allow easy entrance of the hitch bar and locates the load point away from the edge of the reinforcing ring, increasing its strength. Receiver tubes produced according to this invention further reduce manpower and assembly requirements, thus providing efficient production capabilities.

[0011] A further advantage of the present invention is that the cycle time for producing the tubes is reduced by removing the need for heating and, subsequently, cooling the tubes and for

removing the deposits of any carburization that may take place. Further, the metal forming the tube is not weakened due to any molecular effects resulting from the heating step used in the folding method. Thus, the present invention provides a process for cold forming the ends of tubes so as to provide a reinforced portion. By omitting the need for heating the tube prior to the forming step, the various problems discussed previously are avoided. However, it is clear that the present invention is still applicable and productive even if the tube is heated.

[0012] Additional benefits and advantages of the present invention will become apparent to those skilled in the art to which this invention relates from the subsequent description of the preferred embodiment and the appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0013] FIG. 1 is a pictorial view of a trailer hitch assembly in accordance with the prior art.

[0014] FIG. 2 is a pictorial exploded view of the trailer hitch receiver tube according to the prior art construction wherein a reinforcing ring is welded to the end portion of the tube.

[0015] FIG. 3 is a rear view of the receiving end of the receiver tube of FIG. 2 showing the reinforcing ring in place.

[0016] FIGS. 4a to 4d are cross-sectional views of the prior art method for manufacturing receiver tubes wherein a first end portion of the tube is folded upon itself to create the reinforcing ring.

[0017] FIGS. 5 to 8 are cross-sectional views of the present method for manufacturing receiver tubes wherein a first end portion of the tube is not folded upon itself, but plastically deformed to create the integral reinforcing ring.

[0018] FIG. 9 is a perspective view of the preferred embodiment of the present invention after the cold-forging process but prior to drilling of the locking pin apertures.

DETAILED DESCRIPTION OF THE INVENTION

[0019] A trailer hitch assembly according to the prior art, generally designated by reference number 10, is shown in FIG. 1. Trailer hitch assembly 10 generally comprises receiver tube 12, mounting cross members 14 and 16, and hitch bar 18. Trailer hitch assembly 10 can be mounted beneath the vehicle floor pan at the rear of the motor vehicle (not shown) by welding or fastening cross members 14,16 to the vehicle frame members. Receiver tube 12 has a hollow interior passage 20 that closely receives hitch bar 18.

[0020] With continued reference to FIG. 1, when the vehicle operator wishes to tow a trailer, hitch bar 18 is slid into receiver tube passage 20 until the apertures within receiver tube 12 and hitch bar 18, identified by reference numbers 22 and 24 respectively, are aligned. Locking pin 26 is slid though the aligned apertures and retainer clip 28 is passed through a small aperture in the locking pin 26 thereby retaining the locking pin 26 within the apertures. Hitch bar 18 is now connected to the vehicle and is capable of towing a trailer. Hitch bar 18 has a mounting ball 30

that supports a conventional trailer tongue (not shown) for towing the trailer.

[0021] As indicated above, because conventional tube stock includes a weld seam 32 that can affect the strength of the end portion of the tube, reinforcement is needed to strengthen the tube end. Such reinforcement is provided through the use of a reinforcing ring. As described above, there are two modes of construction known in the art for manufacturing a receiver tube having a reinforcing ring; a) welding a separate reinforcing ring on one end of the tube stock, or b) folding an end portion of the tube stock upon itself to create a resultant reinforcing ring.

[0022] FIGS. 2 and 3 illustrate the use of a separate reinforcing ring 36 that is slid onto the end 34 of receiver tube 12 and welded in place. Weld beads 38 are placed on the forward facing junction of the components (shown in phantom lines in FIG. 3) that join the components together. Because it is not practical to assemble tube 12 and ring 36 in a completely flush manner around the perimeter, clearance spaces 40 typically are present at the corners between the receiver tube 12 and reinforcing ring 36. Clearance spaces 40 are undesirable because they detract from the finished appearance of the receiver tube 12 and form areas capable of collecting contaminants. It is further possible, after continued use of the receiver tube, contaminants may also gather between the retainer ring 36 and the receiver tube 12 on the backside of the connection and along positions not welded on the forward facing junction of the components. As indicated above, contaminants can cause corrosion and rusting of the components leading to a weakening of the receiving tube and a creation of an undesirable appearance.

[0023] The second manner of construction for a conventional receiver tube 12 having a reinforcing ring, as illustrated with reference to FIGS. 4a, 4b, 4c and 4d, is to fold an end portion 34 of the tube stock upon itself so as to form an integrated reinforcing ring. As shown in FIGS. 4a through 4d, a receiver tube 12 is placed into a die cavity 44 having recesses 46 and 48 that combine to provide a recess, or void space 50, in the die cavity 44. The void space 50 preferably extends radially and equidistantly from the rest of the cavity so as to form a ring. As shown in FIG. 4a, the receiver tube 12 is placed in the die cavity 44 such that a portion of the end 34 extends above cavity 44. This end portion 34 is then heated so as to make the tube stock more pliable for folding.

[0024] As further shown in FIG. 4b, a mandrel 51 is inserted into the tube 12 whereby the mandrel includes a force-applying flange 52 that is of a greater diameter than the tube 12. A stop 54 is provided that prevents the tube 12 from moving in relation to the die cavity 44. The mandrel 51 and flange 52 is then forced against the receiver tube 12 in the direction indicated by P. The flange 52 imparts pressure against the tube 12 and, in particular, against the end portion 34. This force causes buckling of the tube material within the void space 50. Since the mandrel 51 is inserted within the tube 12, the tube material is deformed radially outwardly into the void space 50, thereby causing the end portion 34 to fold upon itself.

[0025] As illustrated in FIG. 4c, the continued pressure applied by the flange 52 causes the tube material to fold upon itself within the void space 50. In the final stage, as shown in FIG. 4d, the mandrel 51 and flange 52 are advanced until the flange contacts the die. At this point, the tube material has completely folded upon itself and occupies the void space 50 thus creating an integral, reinforcing ring.

[0026] Again, there are several disadvantages with constructing a receiver tube with reinforcing ring by means of folding an end portion of the tube stock upon itself to create the resultant reinforcing ring. First, there is generally a need to heat the tube end to an elevated temperature to promote folding of the tube stock onto itself. Further, given the gap created by folding, there is an increased chance that water, dirt, and contaminants can be lodged within the fold to promote corrosion, which, as indicated above, can affect the strength and appearance of the receiver tube.

[0027] Now with reference to FIGS. 5 through 8, a receiver tube in accordance with this invention is shown generally designated by reference number 60. The receiver tube 60 comprises an elongated hollow tube 62, having a substantially uniform wall thickness, and having first end portion 64. While the hollow tube 62 can be of any configuration, the preferred embodiment utilizes a square cross-section configuration. Other such cross-sectional configurations could be round, oval, triangular, etc. The receiver tube 60 further comprises an

integral lip 66 extending radially-outwardly from the first end 64 that is formed without folding the first end of the hollow tube 62 upon itself.

[0028] The method for cold forging metal tubes of the present invention, preferably receiver tubes for trailer hitch assemblies, is illustrated in FIGS. 5 through 8. Initially, square tube stock 62 is saw cut, tumble blasted with steel shot to remove any saw burrs, and phosphate and soap coated. The phosphate and soap coating serves as a boundary lubricant to prevent the tooling and work piece from welding together during the forming process. The coated tub stock is loaded into the forming die machine as shown in FIG. 5.

[0029] As shown in FIGS. 5 through 8, the integral lip 66 is formed through plastic deformation based upon the sound metal forming criterion whereby the length (L) of the tube stock wall extending beyond the die can be upset without creating a fold in the tube stock, if that length (L) is within a limit of two times its wall thickness (W). Therefore, as illustrated in the FIG. 5, the folding of the tube stock does not occur if the length (L) of tube stock 62 extends beyond the die 68 within a limit of two times the wall thickness (W).

[0030] FIG. 5 illustrates a die 68 that closely receives the outer surface of receiver tube 62. Die 68 partially defines a lip-forming region through rounded interior edges 72. Mandrel 74 includes a first portion 76 adapted to fit within the first end of the tube 62 and a second portion 78 extending radially outwardly from the first portion 76 having a tube deforming recess surface 80

adapted to impinge upon said first end 64. The remainder of the lip-forming region is defined by recess surface 80.

[0031] As illustrated in FIG. 6, the first portion 76 of mandrel 74 is inserted within the first end 64, or receiving end, of receiver tube 60 until the tube deforming recess surface 80 contacts the first end 64. Advancing the mandrel 74 under pressure, as shown in FIG. 7, thereby causes cold deformation of the first end 64, without creating a fold therein, and plastically deforms the first end 64 within the lip-forming region defined by recess surface 80 and die interior edges 72. Continued advancement of the mandrel 74, as illustrated in FIG. 8, results in the formation of integral lip 66 having the shape of the lip-forming region.

[0032] During the construction method, stop 82 prevents the tube from moving relative to die 68. In addition to forming the reinforcing lip 66, mandrel 74 also partially extrudes the inside corners of the tube 62. The portion of the mandrel 74 that fits inside the tube 62 has small radius corners that deform the inside of the tube to a sharp corner further providing an tight-fitting slidable entry for the hitch bar. After the cold forging process described above, apertures are punched in the receiver tube so as to receive the receiver hitch-locking pin. Afterwards, the receiving tube is shot blasted to remove any burrs and residual coating.

[0033] The invention has been described with reference to the preferred embodiment. Obviously, modifications and alternations will occur to others upon a reading and understanding

of this specification. The claims as follows are intended to include all modifications and alterations insofar as they come within the scope of the claim or the equivalent thereof.